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Laparoscopic repair of large diaphragmatic hernia after left ventricular assist device implantation followed by orthotopic heart transplantation

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ABSTRACT

In patients with advanced heart failure and deteriorating clinical status, a left ventricular assist device (LVAD) can be used as a bridge to transplantation or as an alternative to transplantation. An uncommon complication of orthotopic heart transplant or LVADs is diaphragmatic hernia during implantation or explantation of the device. We describe a patient with a diaphragmatic hernia with incarcerated colon and small bowel treated previously with a HeartMate 3 LVAD and subsequent transplantation. This case highlights the need to consider the diagnosis of diaphragmatic hernia based on symptoms after HeartMate 3 implantation and/or subsequent transplantation, as well as the ability to manage these hernias with a minimally invasive laparoscopic approach to minimize postoperative morbidity and mortality.

KEYWORDS Diaphragmatic hernia; laparoscopic repair; left ventricular assist device; orthotopic heart transplantation

Recently, implantable left ventricular assist device (LVAD) technology has improved considerably, providing hemodynamic support with improved functional status and quality of life for patients awaiting orthotopic heart transplantation (OHT) or as an alternative to OHT.[1] A common LVAD is the HeartMate 3 (HM3), a continuous flow assist system featuring a centrifugal pump with a magnetically levitated rotor.[2] Diaphragmatic hernias due to the positioning of the LVAD and driveline in the lower left side of the mediastinum are known complications of LVAD explantation during OHT. Updates to the design of the LVADs have been made to reduce the likelihood of these complications, as earlier devices required incision in the left hemidiaphragm. We describe here a symptomatic patient with a diaphragmatic hernia with incarcerated colon and small bowel who was treated previously with a HM3 LVAD and subsequent OHT.

CASE DESCRIPTION

A 61-year-old man with heart failure treated with an implantable cardioverter defibrillator, LVAD placement, and OHT 3 years earlier presented to the hospital after 2 episodes of "losing his breath." On both occasions he had a lapse in memory and required immediate air transport to the hospital. The patient denied any adjacent traumatic events in his past that could have led to his symptoms. There was no indication of compromise to his OHT, as he was monitored closely upon admission. An infectious etiology was ruled out with serial laboratory tests and culture. Computed tomography of the chest 2 years and 3 years after his heart transplant demonstrated a left-sided diaphragmatic hernia with no signs of bowel obstruction or compromised viscera.

In the operating room, the patient was prepped for laparoscopic entrance into the abdomen. Subsequent enterolysis was performed for 2.5 hours to take down adhesions to identify the defect and reduce the hernia contents of colon, small bowel, and omentum *(Figure 1a and b)*. The defect in the

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The patient has given permission for publication of this case report.
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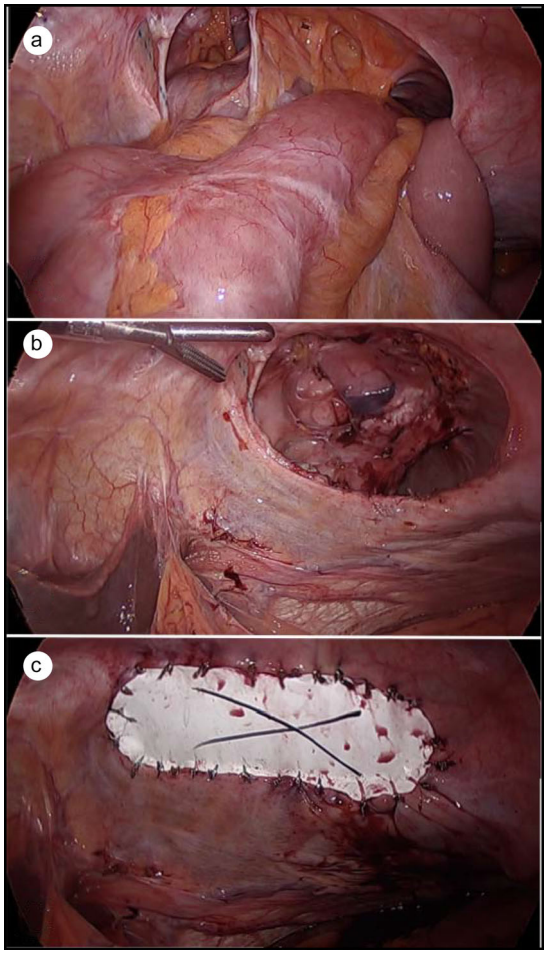

Figure 1. Intraoperative images of **(a)** a large diaphragmatic hernia with herniated colon, small bowel, and omentum; **(b)** reduced diaphragmatic hernia; and **(c)** mesh placement over diaphragmatic hernia.

left hemidiaphragm measured 9×4 cm and was repaired with Gore-Tex mesh (Gore Medical, Flagstaff, AZ) sutured in placed *(Figure 1c)*. The mesh was 2 mm thick and cut to fit the defect. It was circumferentially sutured into place with nonabsorbable 0-Ethibond interrupted suture and secured with Ti-Knots (LSI Solutions, Victor, NY). The procedure lasted 213 minutes and had minimal estimated blood loss. The patient tolerated the procedure with no complications and was discharged 8 days later for management of preexisting kidney disease.

DISCUSSION

This case demonstrates two important points. First, it highlights the continued hernia potential of the HM3, so that hernia should remain in the differential diagnosis for patients with abdominal or chest pain, as well as obstructive-type symptoms. A retrospective study of patients who received the original Thoratec HeartMate (Abbott Laboratories, Chicago, IL) between September 1995 and November 1999 found that 44 patients received the LVAD and went on to receive an OHT. Of these patients, 7 of 44 (15.9%) developed a diaphragmatic hernia after OHT.[3] In the MOMENTUM 3 trial comparing outcomes of HM3 and HeartMate II (HM2) (Abbott Laboratories, Chicago, IL), the rate of rehospitalization for any cause was lower in the HM3 than the HM2 group (2.26 vs 2.4 events, hazard ratio 0.92, confidence interval 0.86–0.99).[4] The data support the superiority of the HM3 to the HM2, likely leading to a rise in HM3 implants with potential bridge to OHT. With the HM2, creation of a pump pocket requires diaphragmatic incision for placement below the left hemidiaphragm.[5] With the HM3, the pump is entirely intrapericardial with less diaphragmatic manipulation. Nevertheless, the possibility of diaphragmatic hernia postoperatively should still be considered in patients after LVAD explantation.

Second, this case shows that these hernias can be managed in a minimally invasive fashion to minimize the postoperative morbidity and mortality and facilitate a rapid recovery. The standard of care for diaphragmatic hernias is a minimally invasive approach laparoscopically or robotically. Currently, there is little literature on diaphragmatic repair overall using the HM3. In only one previous case report, a laparoscopic approach was taken to repair a diaphragmatic hernia after OHT and explantation of the original Thoratec HeartMate.[6] Consulting an experienced minimally invasive surgeon could avoid a laparotomy/possible thoracotomy, decreasing hospital length of stay, wound morbidity, and intraoperative blood loss.[7–10]

In conclusion, we have shown that diaphragmatic hernias can still occur with HM3 despite its truncated approach to implantation. A minimally invasive approach should be the first-line treatment for these types of hernias and was successfully used to treat the large incarcerated diaphragmatic hernia shown here.

DECLARATION OF INTEREST

Dr. Steven Leeds is a consultant for Ethicon and Boston Scientific. Dr. Marc Ward is a consultant for Boston Scientific. All other authors have no conflicts of interest to disclose.

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Avocations

PARADISE IS NO MORE

Those mortals who have a history of
About five million years having survived
Calamities: fires, floods, viruses,
Hurricanes, tornadoes and earthquakes
Man made and environmental events

On a minute ball, in the cosmic terms
In nothingness of space held by tug of
Neighboring planets. Shooting stars hit and
Miss. Some burrowing, leaving craters or
Vanish in the black hole. Foretelling fate
Of worn out objects in the universe

The vast suspended universe that is
Immeasurable by usual means
Makes it unmanageably immense and
Boundless with a minute globe in the midst

Of infinite cosmos occupying
Central place in our limited logic
A people whose ancestors once expelled
From heaven now teeter on extinction
And are at the brink of destroying earth

Nature cries in the form of jolting of
Earthquakes and loud roar of tornadoes
Sending warning salvos of forest fires
Raising the temperature of our earth
Dotted with torrential rains causing floods

If we fail to heed cries of nature and
To see what is staring us in the face
We will lose like the dying sequoia
No amount of foil can stand its fury
To challenge it is to spit in the wind

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